FIG. 1

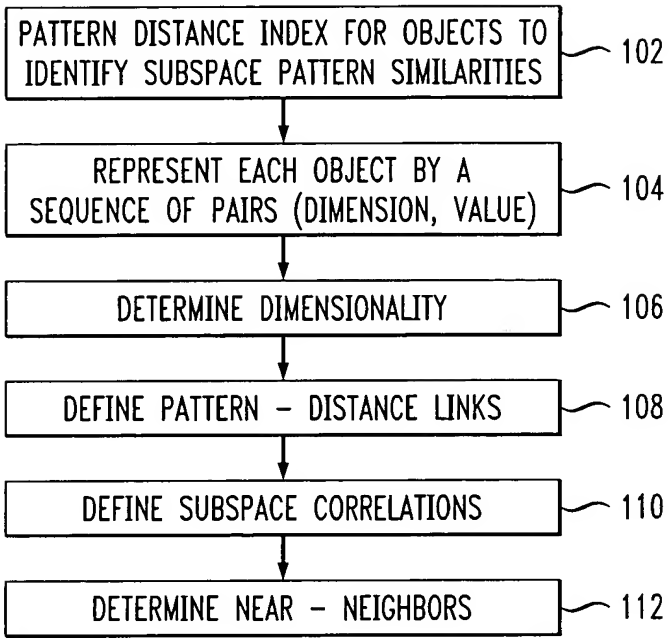


FIG. 2

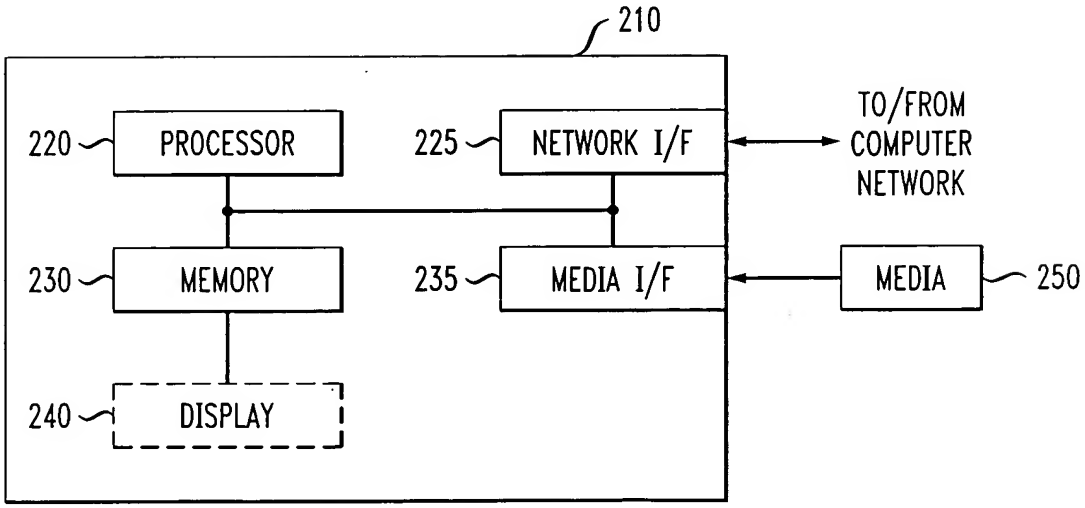


FIG. 3

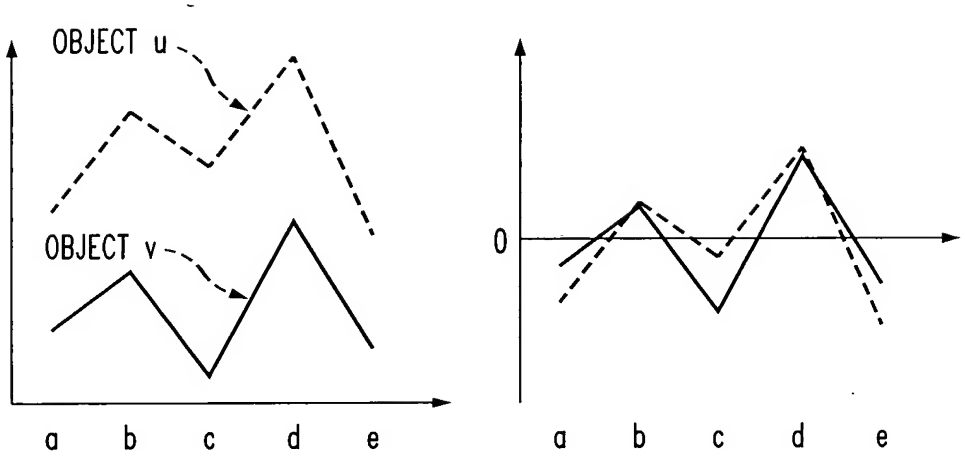

OBJECT u
OBJECT v
a b c d e
0
a b c d e

FIG. 4

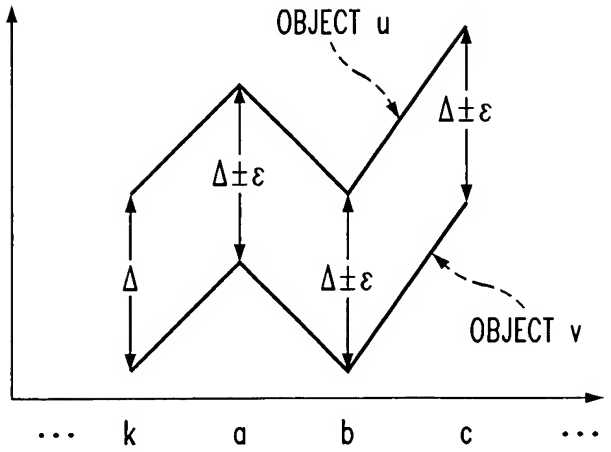

OBJECT u
Δ±ε
Δ±ε
Δ
Δ±ε
OBJECT v
... k a b c ...

FIG. 5

$f(u,i)$, where $u \in \{\#1, \#2\}$ and $i = 1, \ldots, 4$				
$(c_1, 0)$,	$(c_2, -3)$,	$(c_3, 1)$,	$(c_4, -1)$,	$(c_5, -3)$
	$(c_2, 0)$,	$(c_3, 4)$,	$(c_4, 2)$,	$(c_5, 0)$
		$(c_3, 0)$,	$(c_4, -2)$,	$(c_5, -4)$
			$(c_4, 0)$,	$(c_5, -2)$
$(c_1, 0)$,	$(c_2, -3)$,	$(c_3, 1)$,	$(c_4, -1)$,	$(c_5, 2)$
	$(c_2, 0)$,	$(c_3, 4)$,	$(c_4, 2)$,	$(c_5, 5)$
		$(c_3, 0)$,	$(c_4, -2)$,	$(c_5, 1)$
			$(c_4, 0)$,	$(c_5, 3)$

FIG. 6

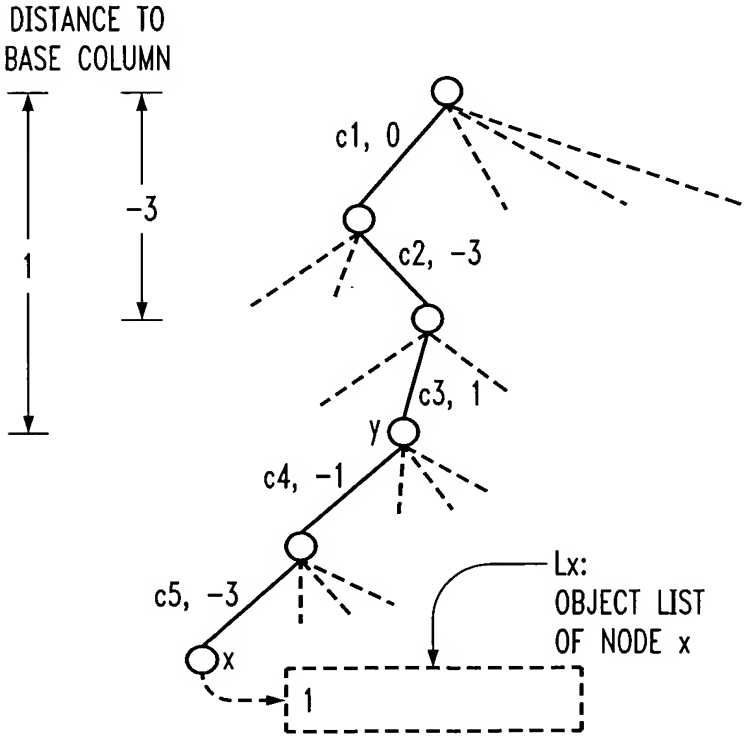


FIG. 7

Input: T: a trie built on D
S: a subspace defined by a continuous column set $\{c_i, c_{i+1}, ..., c_k\}$
$q = (c_1, v_1), ..., (c_n, v_n)$: a query object
ϵ: pattern threshold

Output: near-neighbors of q in subspace S

$n \leftarrow$ root of T;
search(n, S);

Function *search*(x, S)
if $S = \emptyset$ **then**
  output the descendents of x;
else
  assume $S = \{c_j, c_{j+1}, ..., c_k\}$;
  for *x's child node y under edge labeled (c_j, v) where $v \in [(v_j - v_i) - \epsilon, (v_j - v_i) + \epsilon]$* **do**
    search $(y, \{c_{j+1}, ..., c_k\})$;

FIG. 8

Input: D: objects in multi-dimensional space A
Output: PD-Index of D

for *each* $u \in D$ **do**
  insert $f(u, i)$, $1 \leq i < |A|$ into a trie; (Eq 5)

for *each node x encountered in a depth-first traversal of the trie* **do**
  label node x by $\langle n_x, s_x \rangle$;
  let (c, d) be the arc that points to x;
  append $\langle n_x, s_x \rangle$ to pattern-distance link (c, d);

FIG. 9A

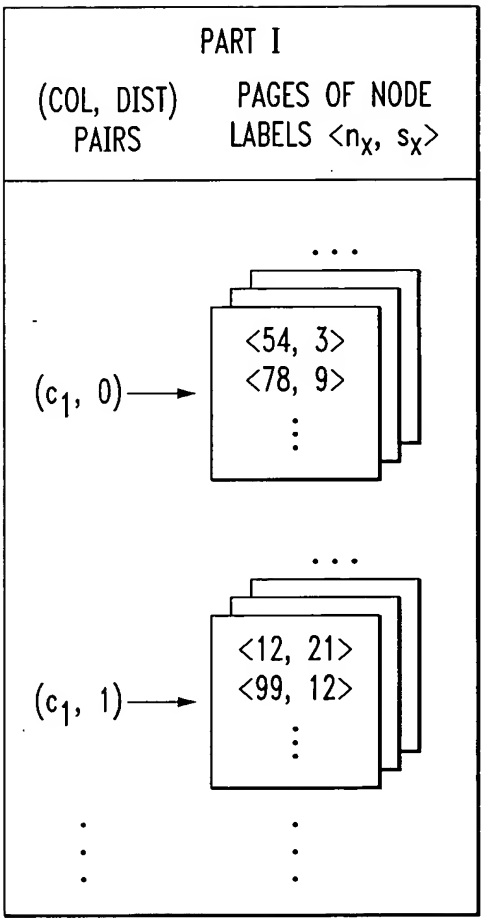

PART I
(COL, DIST) PAIRS
PAGES OF NODE LABELS <n_x, s_x>
(c_1, 0)
<54, 3>
<78, 9>
(c_1, 1)
<12, 21>
<99, 12>

FIG. 9B

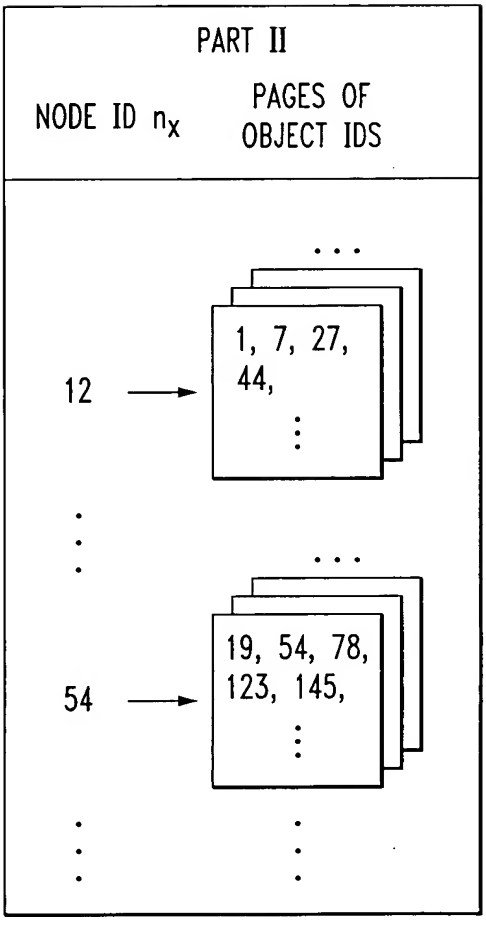
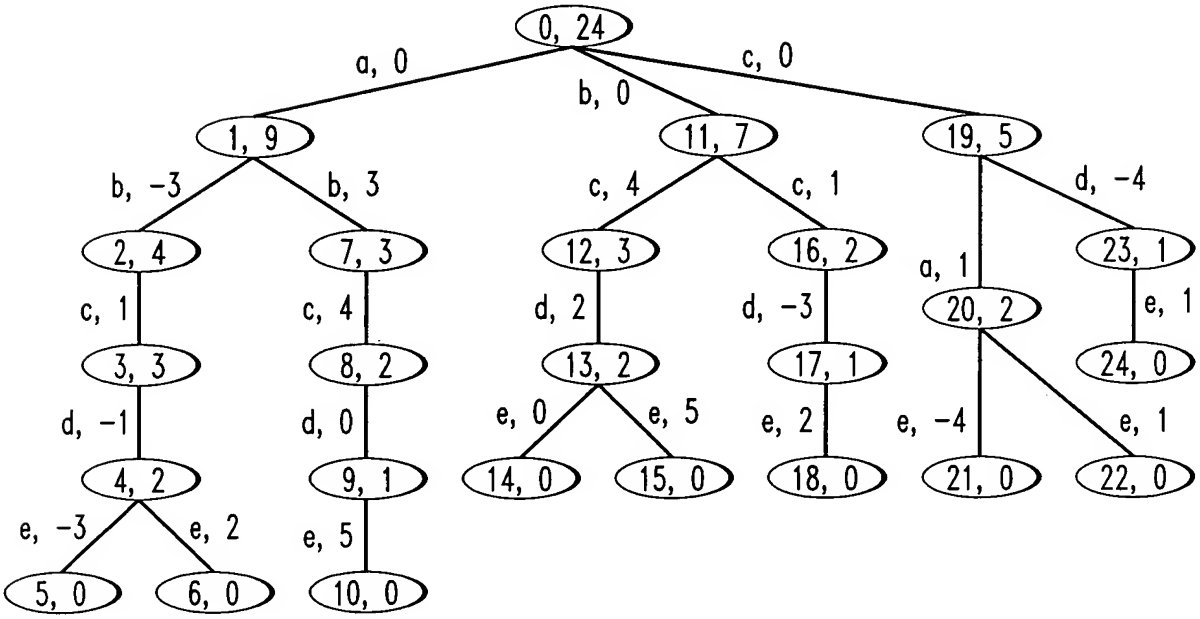

PART II
NODE ID n_x
PAGES OF OBJECT IDS
12
1, 7, 27, 44,
54
19, 54, 78, 123, 145,

FIG. 10

```
Input: q: a query object, S: a given subspace
       ∈: pattern threshold
Output: q's near-neighbors in subspace S

let (c_1, v_1), ... , (c_|S|, v_|S|) be q's projection on S;
x ← the node under arc (c_1, 0);
search(x, 2);

Function search(x, i)
if i ≤ |S| then
    for pattern distance link I of (c_i, v), where v ∈ [v_i -
    v_1 - ∈, v_i - v_1 + ∈] do
        /* perform a binary search on I */
        for all node r ∈ I and n_r ∈ [n_x, n_x + s_x] do
            search(r, i + 1);
        end
    end
else
    output objects in L_x, x = v_s, ..., v_m
end
```

FIG. 11



NODE	5	6	10	14	15	18	21	22	24
OBJS	{1}	{2}	{3,4}	{1}	{2}	{3,4}	{1}	{2}	{3,4}

FIG. 12

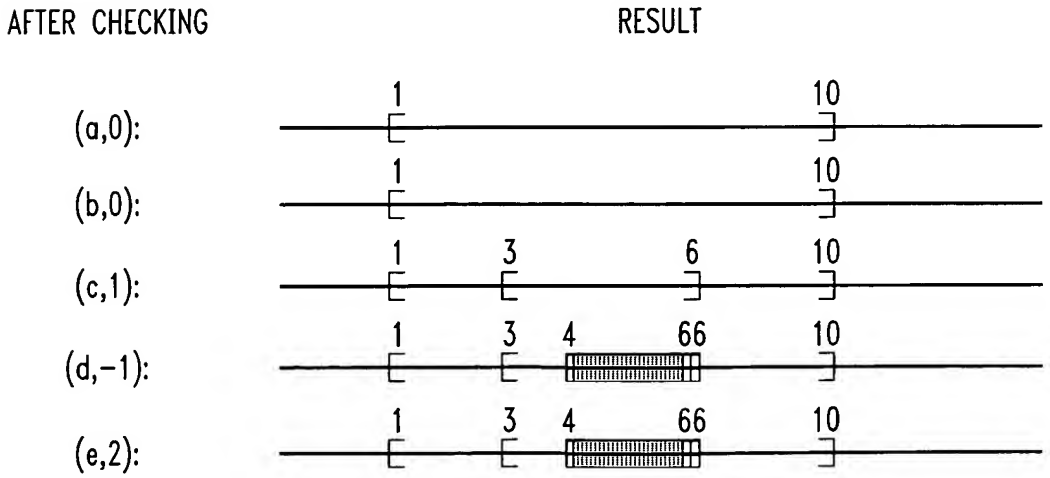
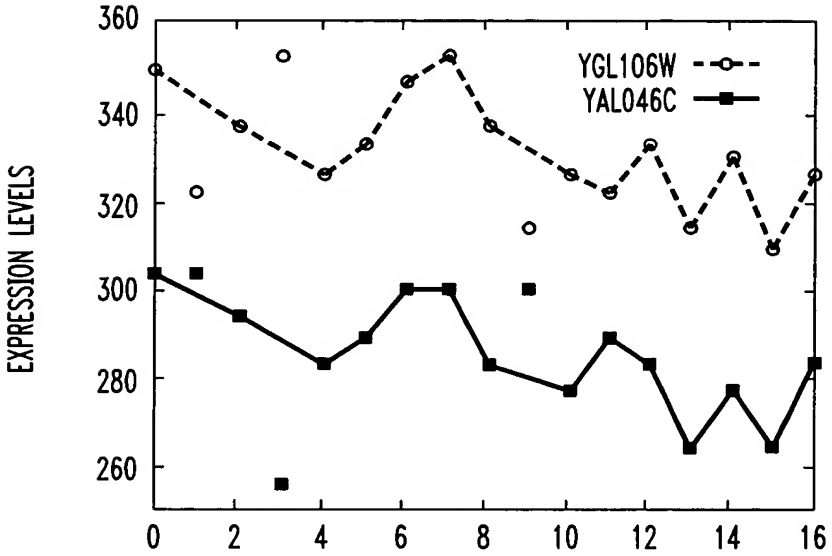


FIG. 13

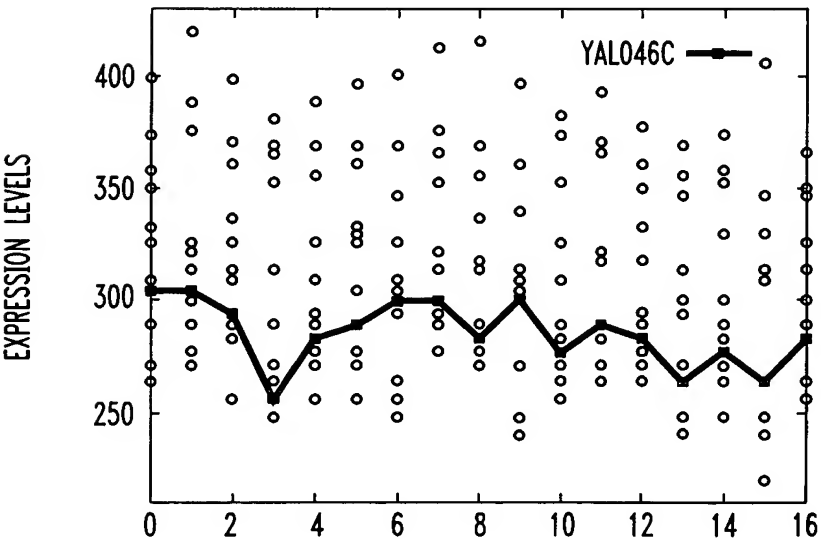
```
Input: q = (c_1, v_1), ... , (c_n, v_n): a query object
       r: distance threshold, ∈: pattern tolerance
       F: index file for D
Output: NN(q, r)

for i = 1, ..., r + 1 do
    R ← the range of the (only) node in link (c_i, 0);
    j ← i + 1;
    while R ≠ Φ and j ≤ |A| do
        search link (c_j, v) for nodes inside any range of
        R, where v ∈ [v_j − v_i − ∈, v_j − v_i + ∈];
        update R by adding the ranges of those nodes;
        if a region s of R is inside |A| − r brackets then
            output objects in L_x where x ∈ s;
            eliminate s from R;
        end
        if a region s of R is inside less than r − j brackets
        then
            eliminate the region from s;
        end
        j ← j + 1;
    end
end
```

FIG. 14A



$pdist(.,.) \leq 3$

FIG. 14B



$pdist(.,.) \leq 4$

FIG. 15A

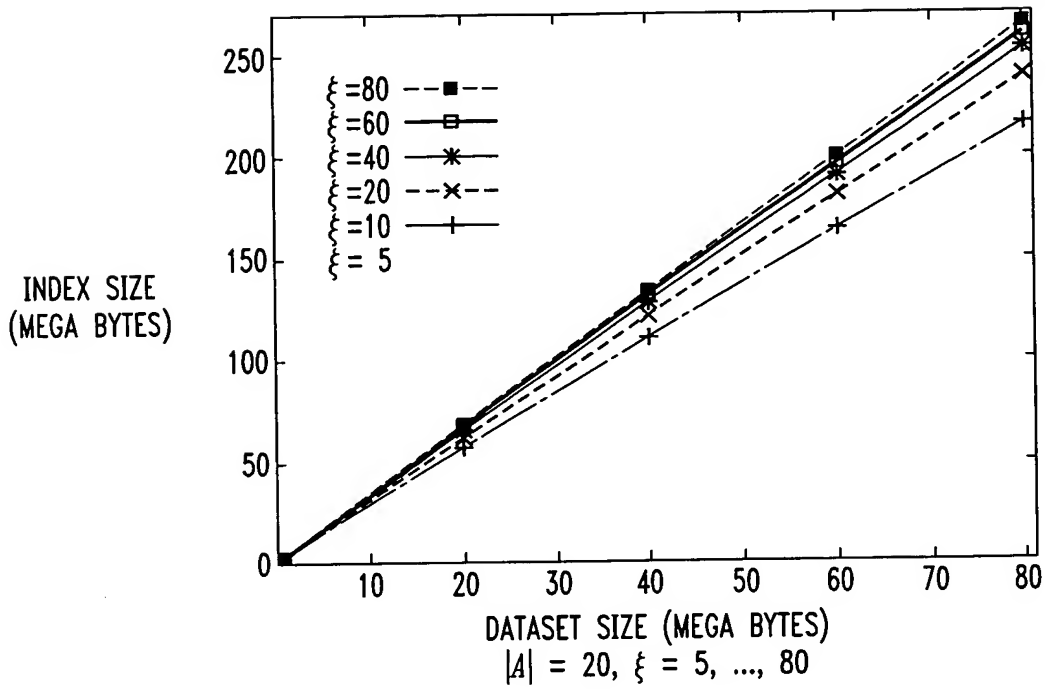


FIG. 15B

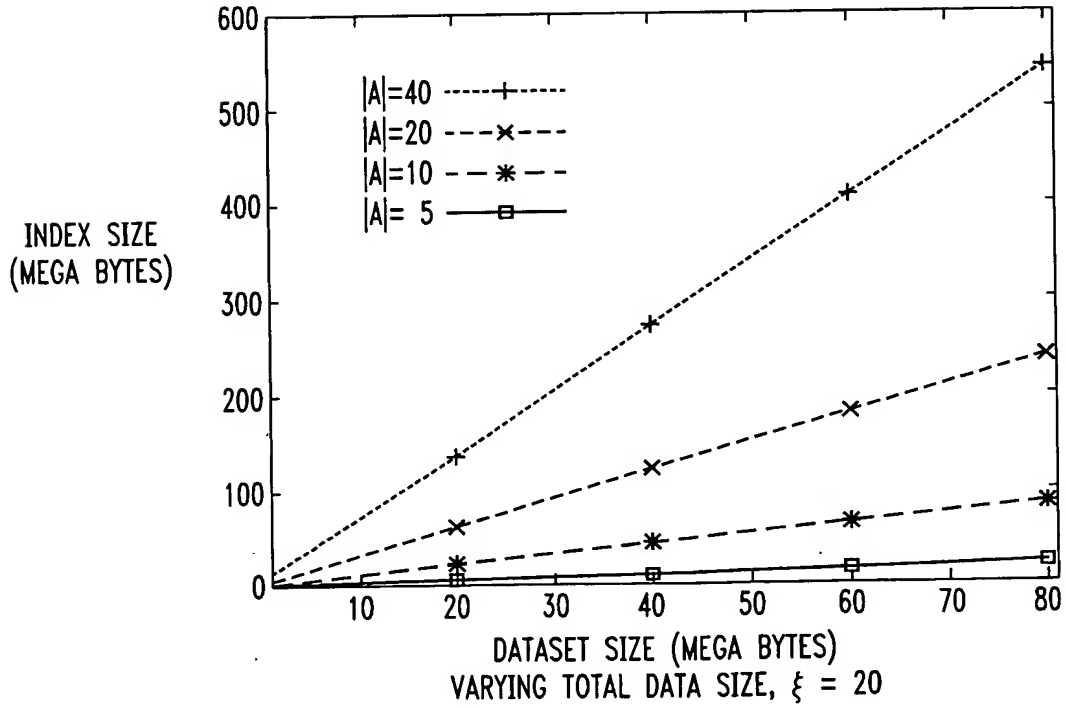


FIG. 15C

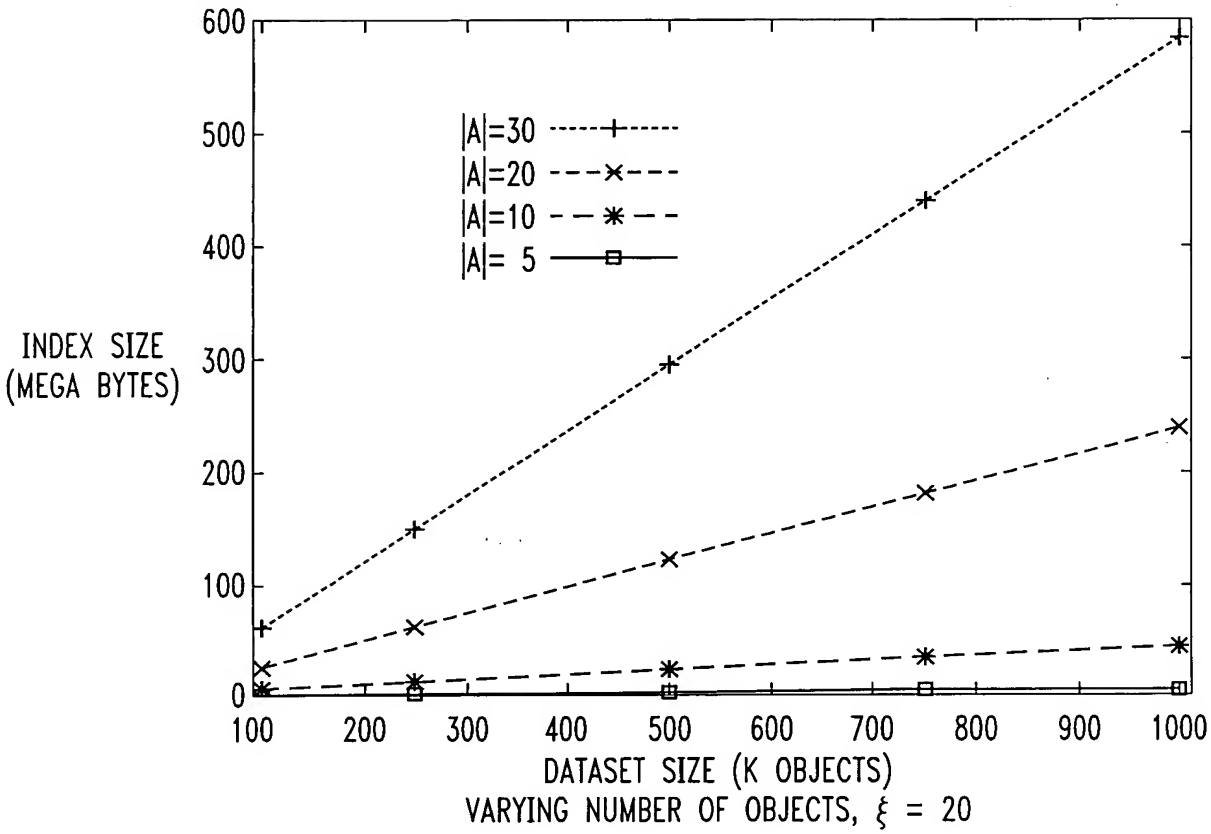


FIG. 16A

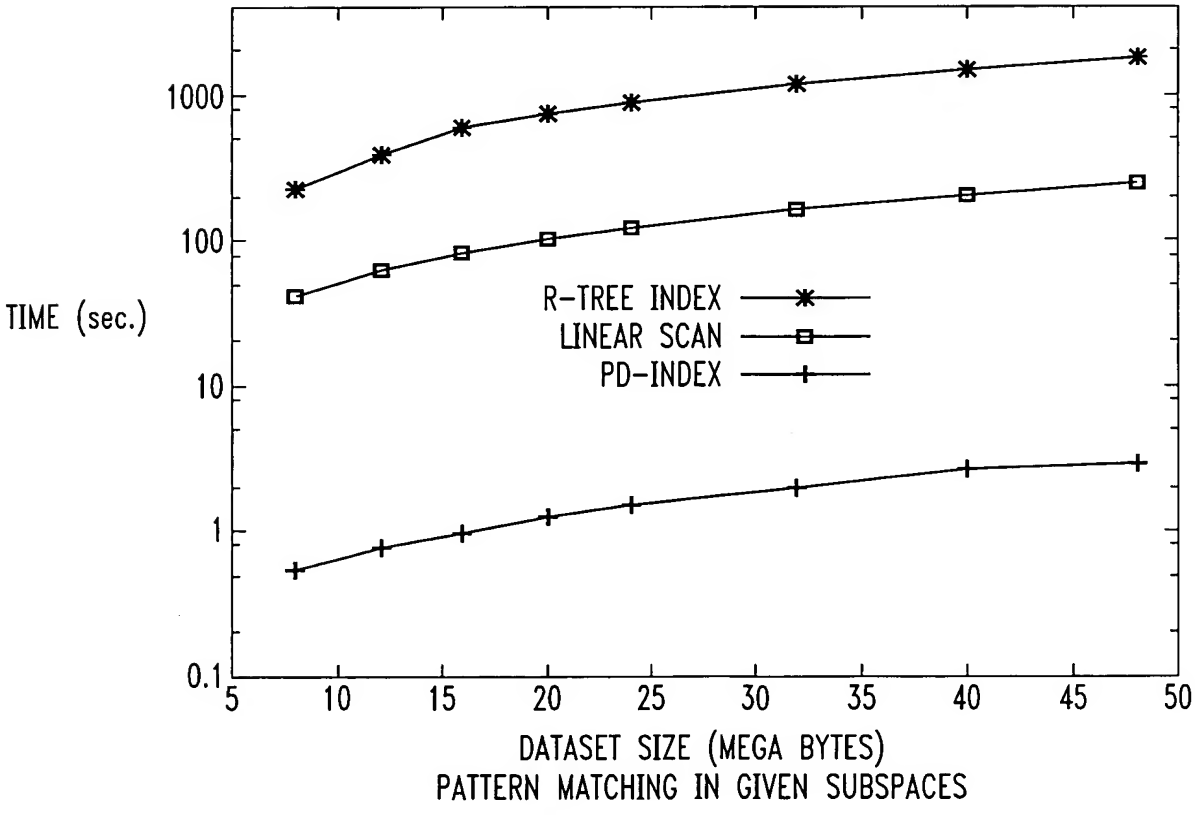
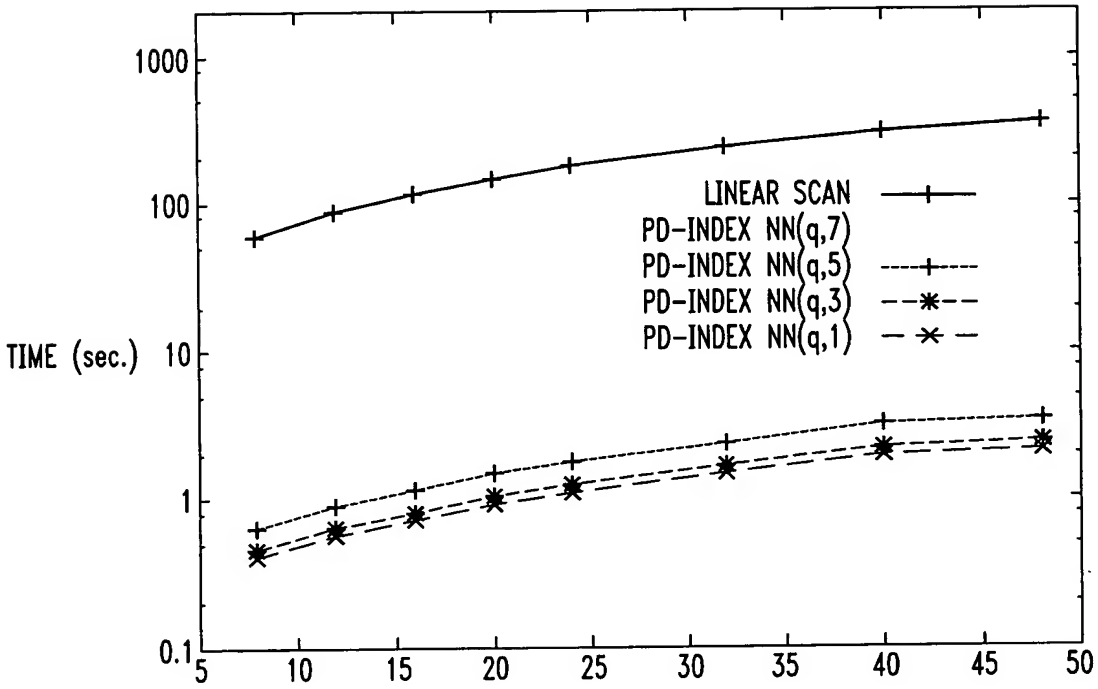
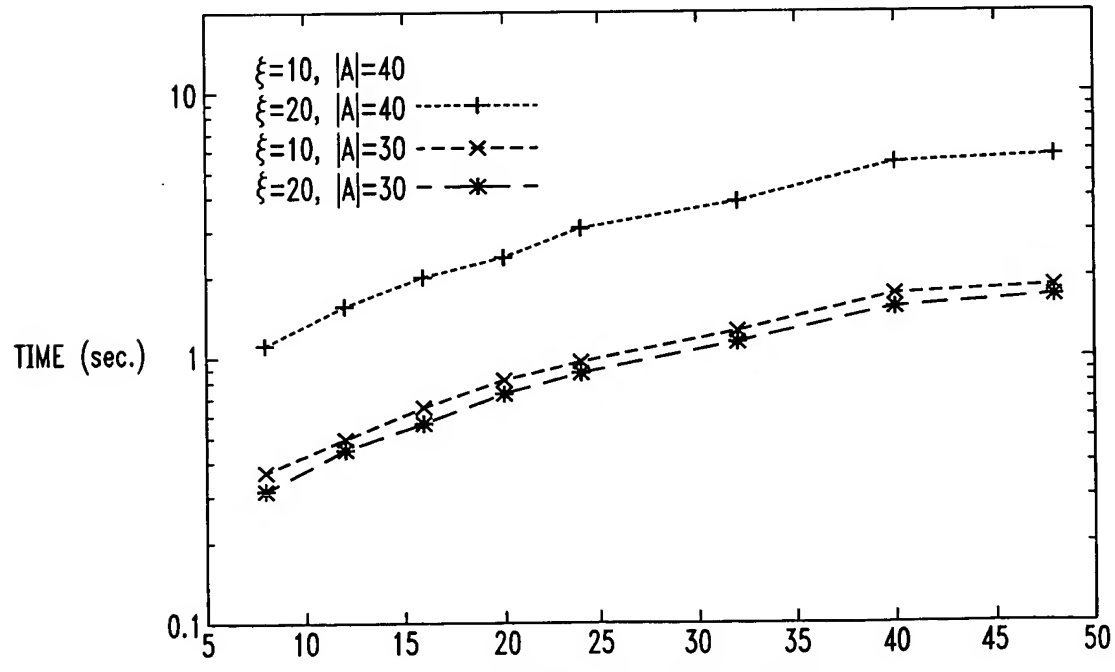


FIG. 16B



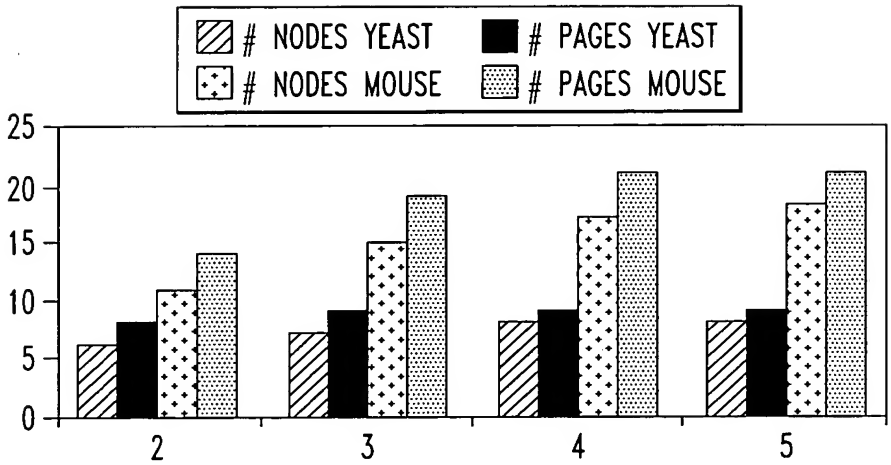
NEAR-NEIGHBOR SEARCH IN SUBSPACES BEYOND GIVEN DIMENSIONALITIES

FIG. 16C



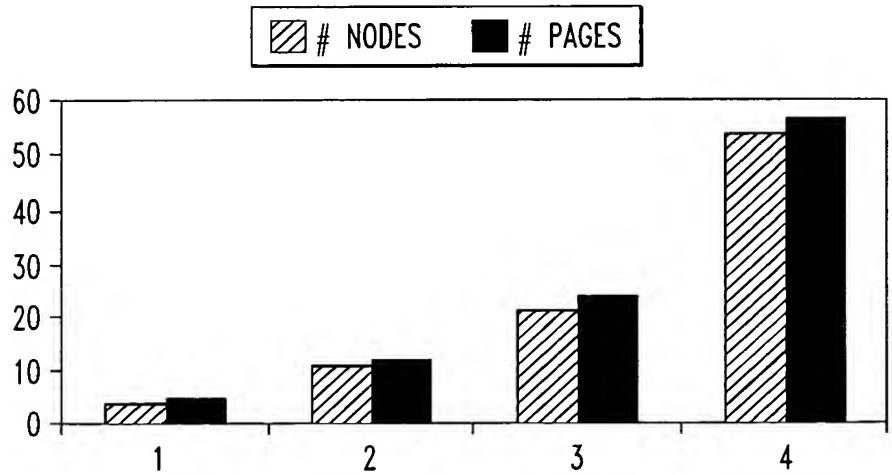
IMPACT OF ξ AND $|A|$ IN NEAR-NEIGHBOR QUERY $NN(q,7)$

FIG. 17A



(a) FIND NEAR-NEIGHBORS IN DNA MICRO-ARRAY IN GIVEN SUBSPACES (X AXIS IS QUERY LENGTH)

FIG. 17B



(b) FIND NEAR-NEIGHBORS IN DNA MICRO-ARRAY (X AXIS IS THE DISTANCE RADIUS r)